DOCUMENT RESUME

ED 464 198 UD 034 993

AUTHOR	Taylor, Chris; Gorard, Stephen; Fitz, John
TITLE	Segregation between Schools and Levels of Analysis: The Modifiable Areal Unit Problem. Measuring Markets: The Case of the ERA 1988. Working Paper.
INSTITUTION	Cardiff Univ. (Wales). School of Social Sciences.
SPONS AGENCY	Economic and Social Research Council, Lancaster (England).
REPORT NO	WP-40
ISBN	ISBN-1-87-2330-347
PUB DATE	2001-00-00
NOTE	29p.
CONTRACT	R000238031
AVAILABLE FROM	For full text: http://www.cardiff.ac.uk/socsi/markets.
PUB TYPE	Reports - Evaluative (142)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Competition; Disadvantaged Youth; *Educational Research; Foreign Countries; *Free Enterprise System; School Choice; Secondary Education; Socioeconomic Influences; *Socioeconomic Status
IDENTIFIERS	England; Wales

ABSTRACT

This paper reviews the use of a segregation ratio in analyzing changes in the pattern of socioeconomic segregation between schools in England and Wales, addressing how the modifiable areal unit problem affects results. Researchers are developing methods for assessing socioeconomic stratification among school admissions and for comparing those across time and place. The best measure shows that school admissions have become more even since 1988. While there are variations in levels of change between areas of England and Wales, findings are consistent at all levels of aggregation, from school to national. The remaining problems are whether the precise definition of the area of analysis affects the results, whether researchers should use economic and administrative borders, and whether it would make any difference if researchers used natural markets or approximate areas of competition for each school. This paper examines the effects of the modifiable areal unit problem on the segregation index and segregation ratio, concluding that using different levels of analysis in calculating the segregation ratio actually focuses on different segregation levels. Therefore, differences between them are equally valid and informative. However, in the case study examples, year-to-year changes are similar no matter what levels of analysis are used. (Contains 15 references, 7 figures, and 4 tables.) (SM)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 464 198

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

MEASURING MARKETS: THE CASE OF THE ERA 1988

www.cardiff.ac.uk/socsi/markets

A Cardiff University School of Social Sciences ESRC-funded Project

WORKING PAPER 40

Segregation between schools and levels of analysis: the modifiable areal unit problem

Chris Taylor, Stephen Gorard and John Fitz

2001

Cardiff University School of Social Sciences
Glamorgan Building
King Edward VII Avenue
Cardiff
CF10 3WT

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

C. Taylor
Cardiff Univ School of Social Sciences

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Email: gorard@cardiff.ac.uk

ISBN 1 872330 347

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

UD 034 993

BEST COPY AVAILABLE

Segregation between schools and levels of analysis: the modifiable areal unit problem

Chris Taylor, Stephen Gorard and John Fitz

Cardiff University School of Social Sciences
Glamorgan Building
King Edward VII Avenue
CF10 3WT, UK
email: gorard@cardiff.ac.uk

Introduction

We are currently engaged in a project entitled 'Measuring markets in the public sector: the case of the Education Reform Act 1988' and funded by the ESRC (grant number R000238031). As part of this we are developing methods for the assessment of socio-economic stratification among school intakes, and for comparing these across time and place (Gorard and Taylor 2000, Taylor et al. 2000a). Our best measure at present shows that the intakes to schools has become more even (i.e. less segregated) since 1988, and that while there are clearly variations in levels of change between areas of England and Wales our findings are consistent at all levels of aggregation from school to national (Gorard and Fitz 2000). Nevertheless, there remains a problem to be faced. Does the precise definition of the area of analysis affect the results? In practical terms, should we use economic and administrative borders and would it make any difference if we used instead natural 'markets' or 'approximate areas of competition' for each school? This is the question explored in the paper.

A key component of all research is the spatial unit of enquiry. This can vary between the individual, the household, a school, a village, a city, a Local Education Authority, or the whole of the UK. Any empirical analysis uses data aggregated to such geographical zones. Often this aggregation is based on an arbitrary decision. For

example, the UK Census collects individual household level data and then aggregates up to a variety of larger zones, such as the Enumeration District, Ward or Local Authority. However, these zones, determined primarily for ease of enumeration, may bear little resemblance to the social geography of the people they contain. Consequently, the analysis of such data in different zones, or levels, may alter the resulting pattern of aggregated observations.

This problem is known as the Modifiable Areal Unit Problem (MAUP) and it possibility has long been recognised and debated by geographers (Openshaw 1984, Tobler 1991, Wrigley 1995). Two components of this affect interpretation of data: a *scale* problem, and a *zoning* problem. The scale problem describes the variation in results due to the progressive aggregation of smaller zones into larger zones, whereas the zoning problem describes the variation in results due to different arrangements of a fixed set of zones, whilst keeping the scale fixed (Kitchen and Tate 2000).

The modifiable areal unit problem is of critical importance in measures of segregation. For example, Wong (1997) argued that the segregation measure, in this case the Dissimilarity Index, was sensitive to scale because of its relationship between the physical clustering of particular population groups and the zoning pattern of enumeration districts used in the measure. Wong (1999) has further shown that the results of measuring segregation could significantly change as a result of using different levels of analysis. However, it is also important to note that in Wong's examination of segregation in thirty US cities that the effects of changing the scale were not the same across each city.

This paper examines the effects of the modifiable areal unit problem on two particular measures of segregation: the segregation index and the segregation ratio. Focussing on socio-economic segregation between schools the discussion begins by outlining the relationship between different levels of analysis and segregation measures. Two particular criticisms of the segregation ratio are then addressed before examining the effects of calculating segregation at various levels of analysis on a number of secondary schools in England.

Measuring segregation between schools

The use of indices to measure segregation between schools in education has already been discussed at length. This has generally focussed on the accuracy of the traditional Dissimilarity Index, as advocated by Duncan and Duncan (1995), and its compositional invariance (Taylor et al 2000a). Two alternative measures of segregation have been proposed (Gorard 2000), the Segregation Index (S) and Segregation Ratio (SR). For the purpose of this paper only these two measures will be discussed.

The Segregation Index provides a summary of segregation for a given area, by using the proportion of a particular group in that area and the proportion of all group members in the same area. This area summary of between-school segregation calculates the proportion of, say, children eligible for free school meals who would have to be replaced for there to be no segregation between schools. If S was equal to zero then that would indicate there was no segregation, if it were equal to one then every child eligible for free school meals would have to be replaced, a situation of maximum segregation.

$S = 0.5 * \text{sum} |Ai/X - Ci/Z|$

Where:
Ai is the number of FSM eligible children in school i
Ci is the total number of children in school i
X is the total number of FSM eligible children in the chosen area
Z is the total number of children in the chosen area

In terms of the discussion on the appropriate levels of analysis S is relatively unproblematic. For example, if we wanted to know the proportion of secondary school children eligible for free school meals who would need to be replaced across the whole of, say, England, then the appropriate level of analysis would be England: the calculation would use the number of FSM eligible children and total number of children in every secondary school in England, and the total number of FSM eligible children across the whole of England, and the total number of all children across the

whole of England. Similarly, if we wanted the measure to tell us how much segregation there was at the LEA level then the area used in the calculation would be changed. Consequently, the Segregation Index can be calculated at many levels of analysis in order to reflect the overall degree of segregation at the respective level, such as the country, the economic standard regions, or the LEA (see Gorard and Fitz 2000, Noden 2000).

In the case of the Segregation Index the level of analysis is chosen according to which scale one wishes to discuss the results; all are equally appropriate and equally valid. The Segregation Ratio, however, provides a school-level measurement reflecting the distribution of a particular group of children in each school. In other words it is defined as the proportion of disadvantaged children within a school over or below its 'fair share', where SR would be equal to one for all schools if there was no segregation in a particular year. Consequently, SR can be used to trace the trajectory of segregation for individual schools (see Taylor et al 2000b).

$SR = (A/X) / (C/Z)$

Where:

A = the number of FSM eligible children in a school

X = the number of FSM eligible children in a sub-area

C = the total number of children in a school

Z = the total number of children in a sub-area

The critical element to this measurement is that the SR of a school is determined by the relative levels of segregation in other schools. If the SR of one school was equal to 1.5, indicating that this school had 50% above its 'fair share' of a particular sub-group of children, then there would have to be at least one other school with SR less than one, i.e. with a proportion of disadvantaged children less than its 'fair share'.

The critical factor in SR is the derivation of the 'fair share', typically defined by the proportion of FSM eligible children across all schools in a particular area. For example, the 'fair share' could be based on the proportion of children eligible for free

school meals in all schools in England. In this case the SR would indicate the proportion of such children in a school relative to the overall proportion in England. Similarly, the 'fair share' could be based on the proportion of FSM eligible children in a Local Education Authority, and so forth. The choice of such scales will alter the value of each schools' segregation ratio, but not their local rank order in terms of disadvantage. Also, the choice of an area from which to base a school's 'fair share' could be further complicated by the nature of market reforms to education. Schools are located in competition spaces from where they compete with other schools for children. However, defining these competition spaces is a complex task, and tend to occur at different scales (Taylor 2001).

An appropriate level of analysis for school segregation?

Clearly, as with all measures of segregation, the level of analysis is an important component of S and SR. Both measures use some form of geographical zone in the calculation of segregation. It has already been suggested that this is unproblematic for the segregation index as it is, by definition, an area summary – the choice of area will be consistently appropriate at whatever respective spatial scale this summary calculation represents.

In the case of the Segregation Ratio changing the basis of the 'fair share' could affect the results. A straightforward example of this would be in the use of an England-derived SR in comparing the levels of segregation between two schools, one located in a northern de-industrialised city and the other located in a relatively affluent suburb in the south east. Critics of the Segregation Ratio could argue that any comparison of these two schools would be wholly inappropriate simply because the overall levels of poverty in these two areas is significantly different to start with. In the context of the modifiable areal unit problem this would constitute a scale problem, the use of England as the aggregate basis from which to calculate the 'fair share' ignores significant regional variations such as the North-South divide.

Potential compromises to this could be to use the schools' respective economic standard regions as the basis for calculating the 'fair share'. Consequently the

resulting segregation ratios would indicate any trends in desegregation, or segregation, to, or from, the overall proportion of disadvantaged children in the economic standard region. Again, it could be argued that using economic standard regions may hide disparities in the distribution of poverty *within* such regions, and, therefore, underestimate the levels of socio-economic polarisation in schools. As before, reducing the scale of the geographical zone to, say, the LEA, would, theoretically, appear to reduce this problem. If one were to accept this criticism of the segregation ratio then this line of argument would eventually lead us to ask at what scale would the impact of overall intra-regional variations in poverty on trends in school segregation be minimised.

Intuitively, critics could argue that when measuring changes in the levels of disadvantaged children in a school the 'fair share' should reflect the overall levels of disadvantaged children in schools that are competing with each other. This argument appears to make a great deal of sense, particularly if we are interested in the effects of the market on the social mix of school intakes. Since the impact of the market on changes in the composition of a school is only affected by the movement of children between schools then the relative composition of a school should only be measured against the schools it gains or loses to. If this argument were accepted then the use of a defined competition space would appear to be the most appropriate geographical zone to use in the calculation of the segregation ratio. This would seem to provide a neat solution as the scale of the chosen geographical zone would simply reflect the spatial extent of competition. In other words, calculating the segregation ratio of an urban school would probably require more schools to be incorporated into the calculation of the 'fair share' than in the case of rural schools.

A way forward?

This critique of the segregation ratio is based on two, but highly related, concerns. The first issue relates to scale. Clearly the segregation ratio for each school can be calculated for a number of different scales, but at what scale should a school's 'fair share' be measured from? There is often the assumption in research that the smallest scale of analysis should be employed, however, it must be remembered that

calculations at any scale produce equally valid conclusions. For example, if school segregation ratios were calculated at the national, say England, scale then the results would indicate the extent a school has above or below the national share of disadvantaged pupils. As indicated earlier this would not account for regional changes, such as the north-south divide in England, however, if we wanted to know to what extent schools were segregating against one another, while incorporating regional demographic change then this would be a perfectly valid calculation. From this calculation it would be possible to conclude whether there is a growing divide in the socio-economic characteristics of school intakes across the whole country, irrespective of regional shifts in the socio-economic characteristics of the population at large.

Similarly, if segregation ratios were calculated at the LEA level the resulting conclusions would also be a valid indication of how over- or under-represented disadvantaged children were in each school against the LEA 'fair share'. Using this scale removes large regional changes in the socio-economic composition of the population. This is best illustrated by the hypothetical example given in Table 1. The segregation ratios of two schools in two different LEAs are calculated for 1989 and 1999. Using all the schools in England to calculate the 'fair share' of disadvantaged pupils in the schools shows that over time School A has, by 1999, the same proportion of FSM pupils in its intake as the overall proportion of FSM pupils for the entire school population of England. School B has moved closer to the England 'fair share' but continues to have above the England proportion of FSM pupils in its intake. However, when the segregation ratios are used based on the respective LEA proportion of FSM pupils the conclusions say something different. In this case School B now has its 'fair share' of FSM pupils for the LEA it is located in, whereas School A continues to have above its LEA 'fair share'. Even though these two scenarios appear to provide contradictory stories both are equally valid. The difference between them can be accounted for by changes in the regional pattern of disadvantaged pupils. For school B to have a lower segregation ratio in 1999 than School A, even though its England segregation ratio is higher than School A's, must indicate that LEA B has relatively more FSM pupils in 1999 overall. So, while the intake of School B is now equal to its LEA fair share it continues to have more FSM pupils in its intake than the

average English school (note that this crossover is not possible if both schools are from the same local area).

Table 1: Segregation Ratios (using free school meals) at two scales (hypothetical example)

	Segregation Ratio (England)		Segregation Ratio (LEA)	
	1989	*1999*	*1989*	*1999*
School A (LEA A)	1.5	1.0	1.5	1.25
School B (LEA B)	1.5	1.25	1.5	1.0

As already suggested both measures are of equal validity and provide equally interesting conclusions. However, as the hypothetical example in Table 1 would suggest, changing the scale can highlight different patterns of change. If we were more concerned with the effects of the market on school intakes then a smaller scale in calculating the segregation ratios could make more sense. It could be argued that in some cases the LEA level of analysis is still too large a scale from which to measure the relative changes in the composition of school intakes (and it should be recalled that LEAs vary in size from those with no secondary schools to those with hundreds). This leads to the second concern of the critics of the segregation ratio, that is the use of the competition space to calculate segregation ratios.

Even though it has already been argued that the scale of the segregation ratio does not alter the validity of the results let us assume that the segregation ratio should only be calculated at the level of competition between schools. In other words the segregation ratio of a particular school is measured against the overall proportion of disadvantaged pupils in *only* the schools it gains and loses pupils to. In order to calculate the segregation ratio at the competition space scale requires us to identify the schools that each and every school competes against.

This is a complex task since each school's competition space can be very different, even if the schools are located in the same LEA. Figures 1 to 3 show the locations of every pupil admitted to three schools from the same LEA in one year's intake. These

real examples illustrate the different spatial extent of school intakes. Consequently, these three schools compete with a different number of other schools. School A has a very localised intake on the edge of the LEA boundary. This would indicate that this school only competes with neighbouring schools and only those from the same LEA as itself. School B is dramatically different in that its intake comes from across the entire LEA, suggesting that it competes with all the schools in the LEA. Again, nearly all the pupils attending this school came from within the one LEA. This contrasts with School C whose intake extends across the LEA boundary into two other LEAs, while only competing with some of the schools from its own LEA. These three examples clearly illustrate the differences in competition spaces even though they are all from the same LEA.

The complexity in defining the competition spaces raises a number of methodological problems. First, without the use of, say, pupils' home postcodes, can we accurately define the competition space of every school? Schools themselves can state what they believe are the other schools they compete with, but competition between schools is often not spatially confined. An individual school may be able to define all the schools it competes with but it has been shown that some of these competitor schools compete with a different set of schools (Taylor 2001).

This 'linked' competition is illustrated in Figure 4. In School A's case it only competes with School B. Therefore, using School A's competition space in order to calculate its segregation ratio would only be based on changes in the composition of these two schools. However, Figure 4 clearly illustrates that changes in the composition of School B is also affected by movement of pupils with School C. Consequently, even though there is no direct competition between School A and School C, changes in the composition of School C does have an impact upon the level of segregation for School A. In such cases it might make more sense to use all three schools in calculating the 'fair share' from which to measure the segregation of each school's intake. However, consider the effects of this argument if all school's competition spaces are linked to other competition spaces. Because of such linked competition it might not be that implausible to use all the schools from across an LEA.

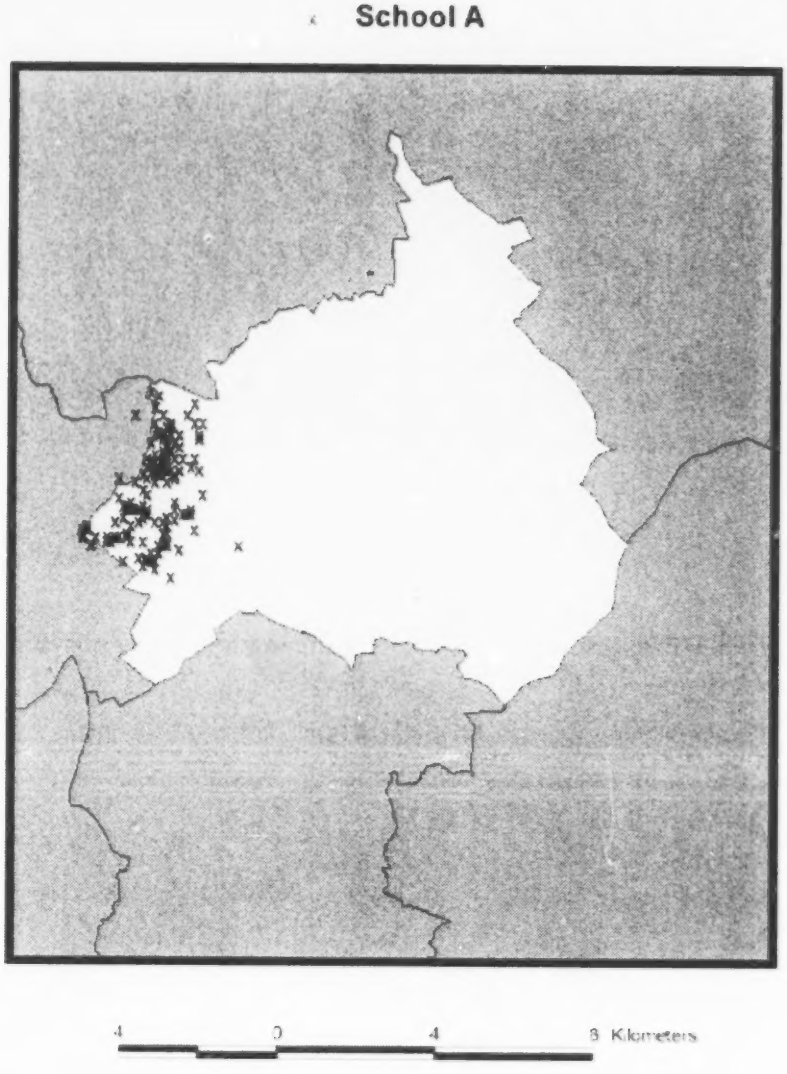

Figure 1: Pupils' home locations for School A

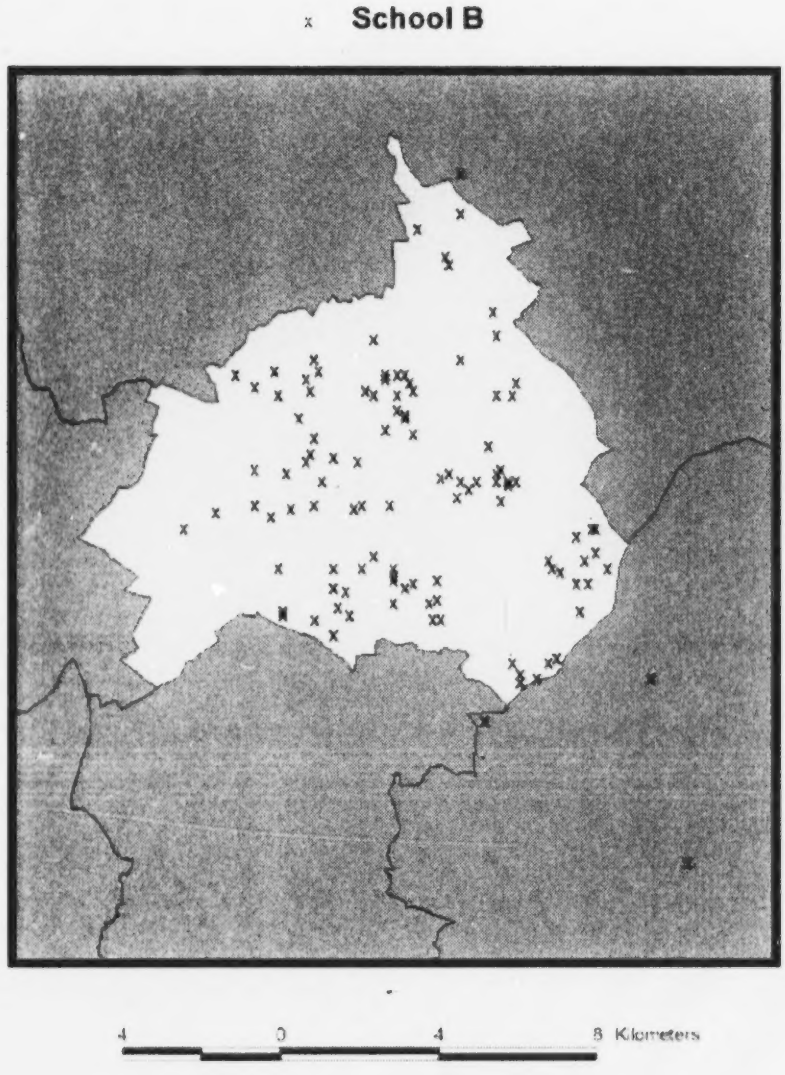

Figure 2: Pupils' home locations for School B

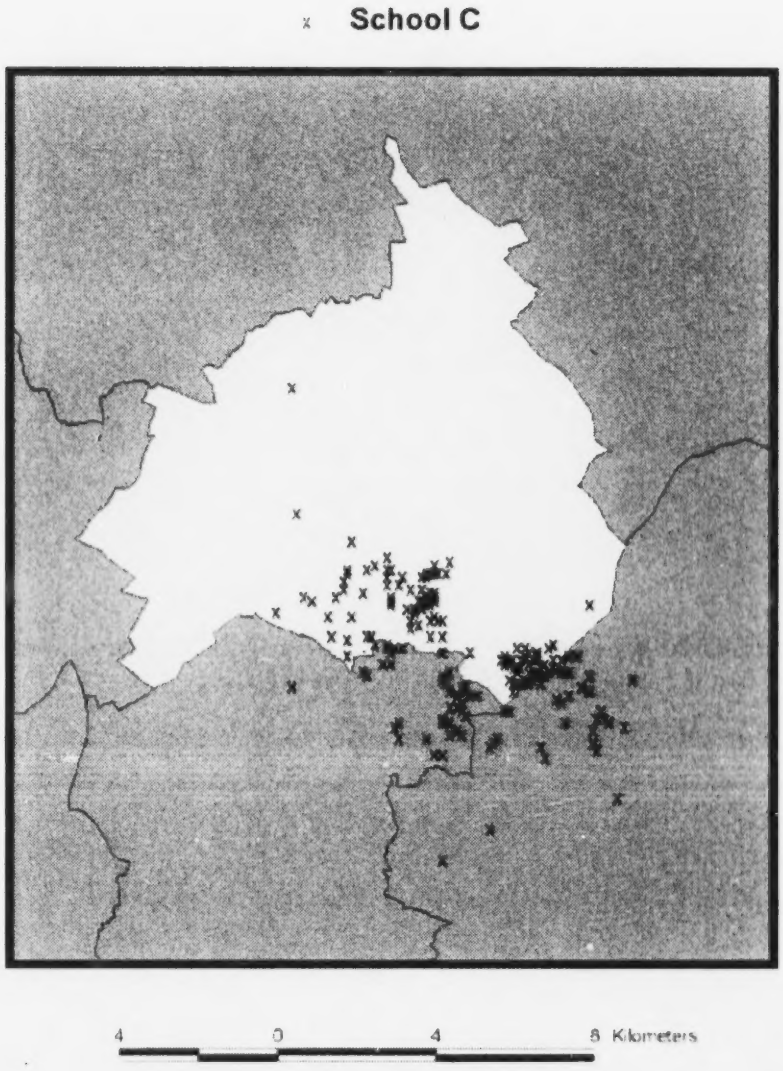

Figure 3: Pupils' home locations for School C

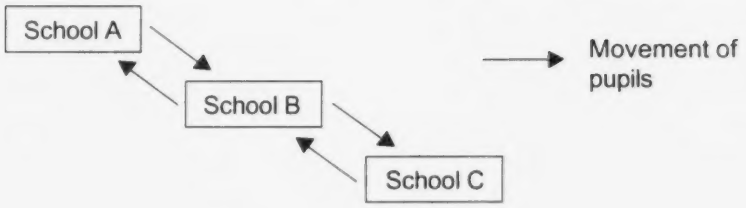

Figure 4: Linked competition spaces

A second methodological problem in defining the competition space of a school is that it can change over time. Therefore, when calculating the segregation ratio over time it may be inaccurate to use the same competition space in 1999 as for 1989. This particular problem further adds to the complexity of identifying a school's competition space.

This response to criticisms regarding the level of analysis in the calculation of the segregation ratio has begun to show that such concerns are not warranted. It would be a pretence to suggest that we can identify discrete local markets. Even if the argument that the school intakes should only be compared against schools where there is actual movement of pupils between them is accepted it is not entirely clear that the competition space of a school is the most useful level of analysis either. Potential critics of our approach would need to be much clearer about whether they wish to argue simply about the number of schools in any areal analysis, or whether they are talking about actual exchange of students. In the absence of school catchment areas this last is a tall order. In order to identify the significance of these criticisms and responses the discussion now examines the impact of different levels of analysis on a number of real school examples across England.

The effects of scale on the segregation ratio in England

The discussion now focuses on four case studies and seven schools in England, and how their respective segregation ratio calculations are affected by using different levels of analysis. These are taken from our national database of schools and their

compositions, from interviews at LEA and school level, and from documentary analysis.

Case study 1: Roman Catholic boys' school, west London

The first example is of a boys' Roman Catholic school in a western outer London Borough. Figure 5 illustrates the segregation ratios over time of this school using four levels of analysis: England; Outer London; the LEA; and the competition space. The first three are easily defined geographic zones. Based on an interview with the Headteacher it was identified that the pupils attending this school came from across six neighbouring London Boroughs. Defining the competition space of this school is already problematic. While the pupils attending this school generally live in these six LEAs it could be argued that the school itself is only in competition with other similar Roman Catholic schools, maybe only just boys' RC school in this part of London. However, as the Headteacher identified himself the boys who do not get a place in this school can go in three different directions. Some may go to alternative local (based on the pupils' home location) Community schools, to other denominational schools, or to one of a number of boys' fee-paying schools. Therefore, accurately identifying the competition space of this school is not straightforward. The segregation ratios illustrated in Figure 5 under the 'competition space' label are based on the proportion of FSM pupils in *all* schools from across the six identified LEAs. All tell the same story.

As Table 2 shows, the pattern of change in the four segregation ratio calculations are fairly similar. Under each calculation of the segregation ratios the trend over time remains the same. The relative level of the segregation ratios along the y-axis reflects the geographic differences of each level of aggregation. For example, by 1999 this school has a proportion of FSM pupils in its intake slightly above average compared to the rest of England, yet when measured against the other three levels of analysis it has slightly below its 'fair share' of FSM pupils.

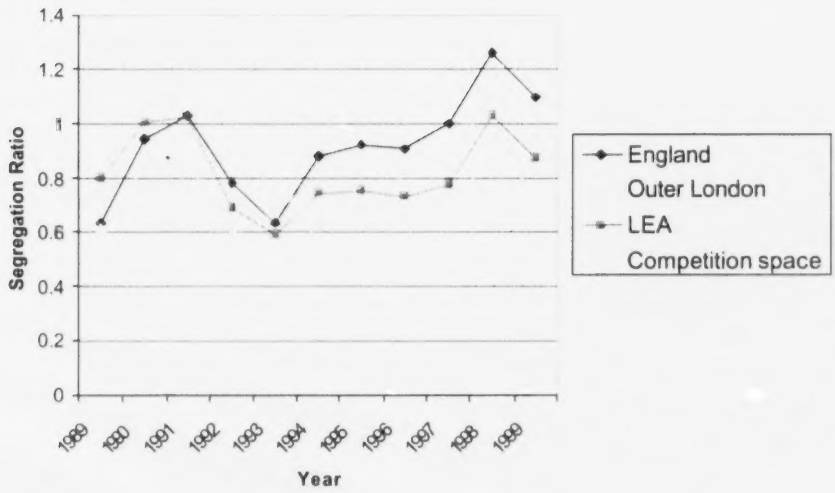

Figure 5: SR trends for a boys' Roman Catholic school

Table 2: Relationship between SR for boys' Roman Catholic school

Correlation Coefficients (R)	England	Outer London	LEA	Competition space
England	*1.00*			
Outer London	0.52	*1.00*		
LEA	0.73	0.93	*1.00*	
Competition space	0.83	0.89	0.97	*1.00*

Even though it might appear that this offers two different conclusions they are both valid. As discussed earlier if we wanted to know how this school compared against all schools in England then the England SR would tell us. If we wanted to see how the intake of this school had changed while allowing for, say, changes in the north-south divide then the other three calculations would be more useful.

Given the relative differences in the final ratios the critical examination of variations in the calculation of SR would be to see if the change in time differs, thereby offering,

perhaps, contradictory conclusions. As both Figure 5 and Table 2 show the year-on-year change in segregation is the same for all four calculations. On balance, the LEA SR provides the most 'average'[1] set of figures over time. The only observation one could make about these trends is that the England SR shows the greatest change between years – again simply reflecting differing rates of change in the proportion of FSM pupils at the national, regional and local level.

Case Study 2: Mixed Community school, west London

The next example is of a mixed Community school located in the very centre of a western outer London Borough. Figure 6 shows the segregation ratio for this school over time based on six levels of analysis: England; Outer London; the LEA; and three distance-based competition spaces. The Headteacher of this school found it difficult to identify a competition space. This was because for several years during the 1990s this school was undersubscribed and, therefore, took pupils from right across the LEA who did not get into any of the other Community schools. By the end of the period this school could fill its places with first choice applicants, hence the spatial extent of its intake differed to that at the beginning of the 1990s.

Because of this, and largely for comparison more than anything else, the three competition space segregation ratios illustrated in Figure 6 are determined by using the overall proportion of FSM pupils in schools at incremental distances from this school. In other words Competition Space 1 uses the nearest twelve schools to this school, Competition Space 2 uses the nearest eight schools and Competition Space 3 uses the nearest two schools.

As Figure 6 and Table 3 shows, again there are little differences in the SR trends over time. By 1999 this school took more than its 'fair share' of FSM pupils than it did in 1989, whichever level of analysis was used in the calculation. As with the previous example the change over time was greater for the England SR than the other calculations. This example differs from the previous case as the intake of this school moved away from its 'fair share'. These two examples illustrate that even under very different circumstances the segregation ratios at all levels of analysis tend to point to the same conclusions.

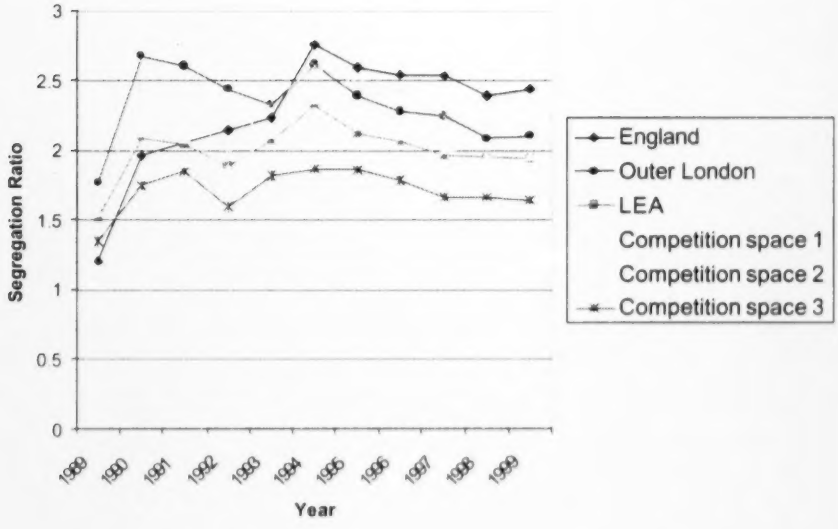

Figure 6: SR trends for a mixed Community school, west London

Table 3: Relationship between SR for mixed Community school, west London

Correlation Coefficients (R)	England	Outer London	LEA	CS1	CS2	CS3
England	*1.00*					
Outer London	0.41	*1.00*				
LEA	0.80	0.80	*1.00*			
Competition space 1	0.78	0.78	0.99	*1.00*		
Competition space 2	0.79	0.73	0.97	0.98	*1.00*	
Competition space 3	0.72	0.77	0.94	0.95	0.92	*1.00*

Case Study 3: Oversubscribed mixed Foundation school, north west London

The third example is of an oversubscribed mixed Foundation school from north west outer London. Figure 7 illustrates the segregation ratios at three levels of analysis: England; Outer London; and the LEA. This school provides an example where the competition space of the school is almost impossible to outline. The intake of this school is complicated by two factors. First, it has 15% selection, i.e. 15% of its places are allocated according to the results of the school's own admissions ability test. These pupils typically come from across a large area of north-west London. The remaining 85% of places are allocated by the school's own admissions criteria, that of sibling connection and distance, as measured by a straight line from the school to the pupils' home. The second complication of this school's intake results from these oversubscription criteria. Over the last ten years both of these criteria have, effectively, reduced the spatial extent of the remaining 85% of places. At the beginning of the period this school attracted pupils from right across the Borough. As it became increasingly more popular the distance from which pupils were able to get a place has fallen. By 1999 the 85%, non-selective, places were given to pupils living no further than 1km from the school.

As a result of the complex and changing nature of this school's intake it is almost impossible to identify which other schools it competes with. In this case the best proxy for the competition space is the LEA, but even then 15% of places tend to go to pupils in adjacent LEAs.

As Figure 7 and Table 4 shows there is still very little difference in the changes over time of the three segregation ratios. This example shows quite clearly how the level of analysis is related to the degree of change in SR results over time. As the spatial unit used gets smaller then the level of change over time also falls. As a result different, but, again, equally valid, conclusions can be made. Relative to all schools in England this school began the period with below its 'fair share' of FSM pupils. By the end of the 1990s it was well above the English 'fair share'. The other two segregation ratios suggest that, given this, the composition of this school's intake is actually more similar to schools in Outer London or just those in the LEA.

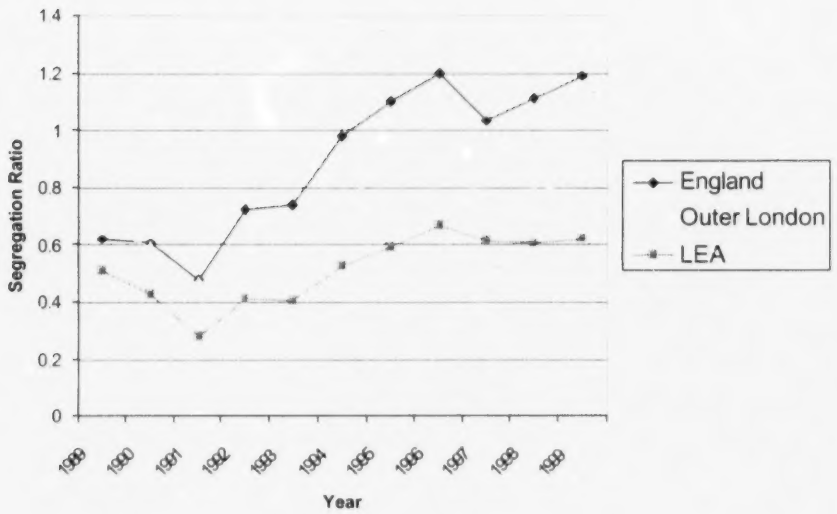

Figure 7: SR trends for a mixed Foundation school, north west London

Table 4: Relationship between SR for Foundation school, north west London

Correlation Coefficients (R)	England	Outer London	LEA
England	*1.00*		
Outer London	0.96	*1.00*	
LEA	0.92	0.94	*1.00*

Case Study 4: A contained urban competition space

The fourth case study considers four schools all located in or just on the outskirts of an urban area in a south east county LEA. These four schools were chosen as they represent a contained urban competition space where there is little movement of pupils out of the urban area to other schools. In the context of the earlier discussion this avoids the problem of linked competition spaces. All four of these schools are co-

educational, but one is a Foundation school. Figure 8 illustrates the segregation ratios of all four schools based on four levels of analysis: England; the South East; the LEA; and the competition space as defined by the four schools. This example perhaps provides the most 'ideal' scenario for examining the effects of using arbitrary geographic zones in calculating segregation ratios over the actual 'lived' competition space.

The first observation to make of these segregation ratios is that the England SR is now lower than the other three. In relation to the previous case studies this reflects the overall level variation in socio-economic deprivation between the South East and London. Even within the South East it is clear that this urban area is relatively less disadvantaged than other areas in the South East.

The distribution of FSM pupils between these four schools at the beginning of the period was highly segregated. Consider, for example, the difference between School A and School D, the former with more than its 'fair share' of FSM pupils and the latter with well below its 'fair share'. Over time the different segregation ratios generally tell the same story. Both School B and School C saw their segregation ratios fall over the period, while the segregation ratios for School D rose over time. Perhaps the main exception to this was in the example of School A.

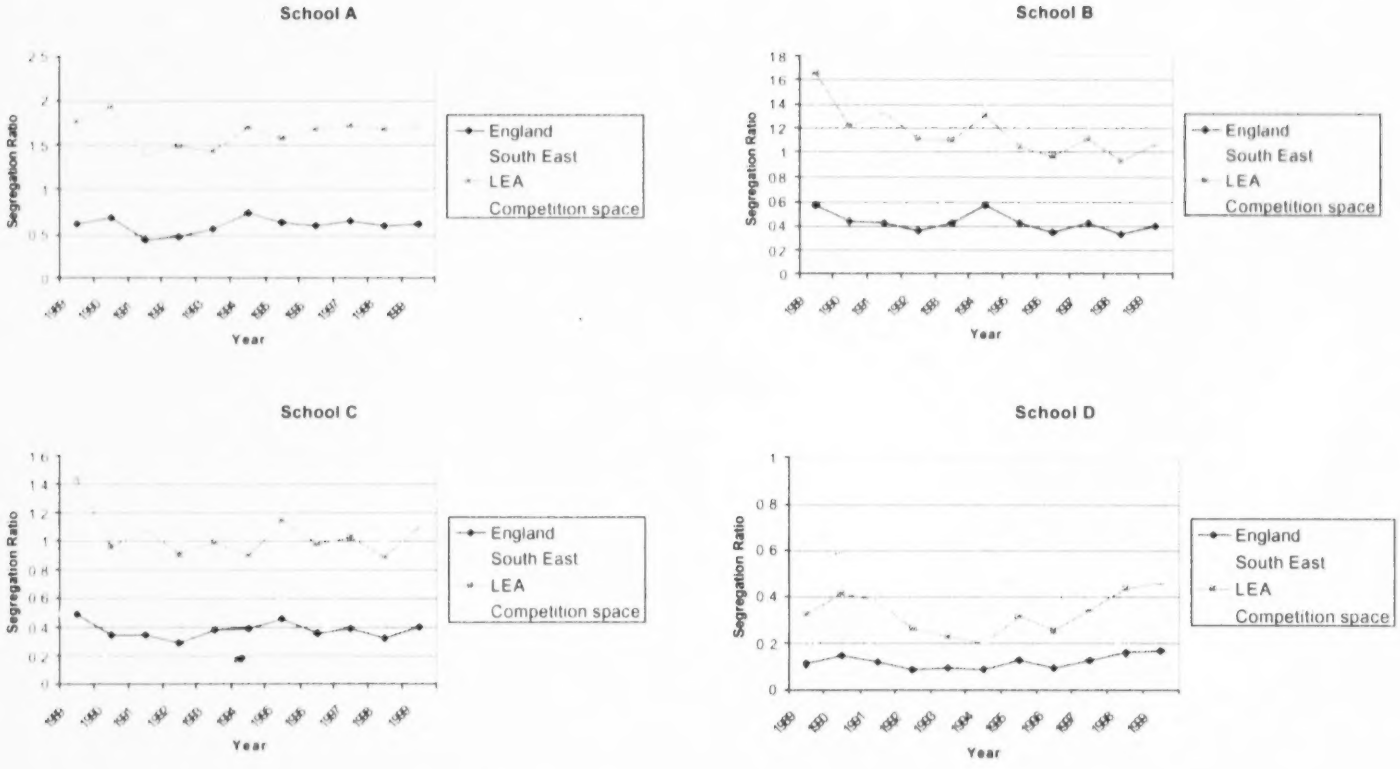

Figure 8: SR trends for four schools in a contained urban competition space, south east England

The story for School A appears to differ according to which segregation ratio we are using. For example, in relation to the overall proportion of FSM pupils in English schools, this school ended the period with approximately the same level of segregation as it did at the beginning. However, the South East and LEA segregation ratios appear to suggest that the levels of disadvantaged pupils in this school actually fell. These contrast further with the competition space SR, which would suggest that this school became more segregated relative to the other three schools in the competition space. Critics would argue that if the competition space was not being used in the calculation of the segregation ratio then this schools intake would appear to be changing in line with other schools. They would argue that the 'real' situation was that this school was in fact becoming more segregated.

A number of observations, however, need to be made. First, one of the reasons that the competition space SR appears to have increased over time was because the 1989 figure was low, relative to the other segregation ratios. So, for example, if we only looked at the trend in segregation from 1991 onwards all four measures would point to increasing segregation. Second, the differences between what the four segregation ratios suggest has happened to School A's intake can largely be explained by the difference in the rate of change year-on-year. In the previous London case studies the England SR generally changed year-on-year at a faster rate than the segregation ratios at other levels of analysis. However, in this case study, the England SR changed at a much slower rate, hence, over time their appears to be little change in this SR compared with the other ratios. This becomes clear if one examines in which direction the segregation ratios move for each year. So, in the example of School A, the England and the South East segregation ratios increased and decreased simultaneously for every year during the period.

The only deviation from this comes from 1995 onwards for the LEA and competition space SRs. Both of these two segregation ratios increased between 1995 and 1996, yet the England and South East SR showed a fall in segregation. Similarly, in the subsequent years the LEA and competition space SRs moved in opposite directions from one another. It is interesting to note, also, that for the other three schools in the competition space the LEA segregation ratio actually shadowed the changes in their respective competition space segregation ratios.

This case study has highlighted the impact that differences in the rate of change between the different use of geographic zones in calculating the segregation ratios can have. However, as discussed earlier, since each of these segregation ratios is in fact addressing different patterns in a school's intake in the first place then this is not necessarily problematic. This case study did produce one example where there was a very slight deviation in the trends illustrated by the four segregation ratios. Interestingly, this deviation was not reproduced in any of the other three schools' patterns of segregation.

Conclusion

This paper has attempted to review the use of the segregation ratio in analysing changes in the pattern of socio-economic segregation between schools. In doing so it has addressed how the modifiable areal unit problem can affect such results.

It has been discussed, and shown, that the use of different levels of analysis in calculating the segregation ratio actually focus on different levels of segregation. Thereby differences between them are equally valid and can actually be informative. However, in the case studies presented here, in nearly every case changes year-on-year were similar whichever level of analysis was used. The only differences that were observable were differences in their overall levels, i.e. their position along the y-axis, and differences in their rate of change over time. Because of these two features it could appear that the segregation ratios do in fact provide different conclusions and outcomes. However, bearing in mind the difference in what these segregation ratios are actually measuring such uncertainty can be abated.

The critical issue that does emerge from this discussion is at what level of analysis is the impact of the market upon individual school intakes best measured. Intuition more than anything else suggests that the most appropriate level of analysis would be at a scale where there is actual movement of pupils between schools. However, defining such competition space, both theoretically and practically, is highly complex. Considering that in the only example where the competition space segregation ratio

deviated from the pattern of change illustrated by the other segregation ratios the overall trend was not greatly affected. In fact the trends over time for the other three schools in the competition space were unaffected.

If the argument that the competition space is the most appropriate level of analysis to measure segregation was accepted then the inaccuracy in defining such a zone in reality surely outweighs the accuracy perceived in theory. What this discussion and examination has shown is that the choice of areal unit should be chosen with great care. There may be some examples where an easily identifiable competition space can be used. But in many more the complexity of competition between schools and the complexity of competition over time would actually suggest that a small unit of analysis may produce inaccurate results.

In the great majority of LEA's, for the great majority of families, the LEA is the arena of choice. LEAs as a unit of analysis are at least linked by relatively similar admissions procedures (Fitz et al. 2001). That is clear from our case studies and also from the other 19 LEAs in which we interviewed. The number of cross-border applicants is greatest in London and the southeast but these patterns cannot be projected onto the rest of the LEAs England and Wales. In our southeast England case study LEAs, Hertfordshire and Brent, in some areas 50% of applicants are out of county. For sure, some schools in some LEAs have very low numbers of local LEA children in the intake: 36% at Dame Alice Owen, 9 % in Lady Margaret in Hammersmith and Fulham - and no doubt there are other spectacular examples. According to our interviewees however, these patterns are long-standing, pre-dating the 1988 legislation. Our own secondary data analysis confirms that view.

Second, it is possible to define a 'market' in simple geographical terms by the drawing a line around the set of schools who report being in competition with each other for students , or, define it via parents reporting the schools that they had considered in the process of selecting a secondary school. These procedures can also be inadequate to the task of defining the 'markets' for the purposes of studying their stratifying effects. For wherever the boundary defining a 'local' geographical market is drawn, some schools will also be occupants of other markets outside the notional boundary. In our view, whichever geographical entity is selected, it will be

inadequate. They will not capture all the schools supposedly de/segregating from each other or not, because all such schools are also members of arena of choice and, therefore, may be changing their social composition in relationship to them. For these reasons, whatever imperfections exist in the employment of LEAs as a unit of analysis, notions of 'local' markets are at least as flawed and probably more so given the first point we made above.

Note

[1] However, this strictly means very little as the use of the SR at each level of analysis has already been shown to represent different trends.

References

Duncan, O.B. and Duncan, B. (1955) Residential distribution and occupational stratification, *American Journal of Sociology*, 60, 5, 493-503.

Fitz, J., Taylor, C., Gorard, S. and White, P. (2001) *Local Education Authorities and The Regulation Of Educational Markets: Four Case Studies*, Occasional Paper 41, Cardiff: School of Social Sciences, ISBN 1872330460

Gorard, S. (2000) *Education and Social Justice*, University of Wales Press, Cardiff.

Gorard, S. and Fitz, J. (2000) Markets and stratification: A view from England and Wales, *Educational Policy* , 14, 3, 405-428

Gorard, S. and Taylor, C. (2000) *A comparison of segregation indices used for assessing the socio-economic composition of schools, Measuring Markets: the case of the ERA 1988 Working Paper 37*, Cardiff: School of Social Sciences, ISBN 1872330347, 51 pages

Kitchen, R. and Tate, N.J. (2000) *Conducting Research into Human Geography*, Pearson Education Ltd., Essex.

Noden, P. (2000) Rediscovering the impact of marketisation: dimensions of social segregation in England's secondary schools, 1994-99, *British Journal of Sociology of Education*, 21, 3, 371-390.

Openshaw, S. (1984) The modifiable areal unit problem, *Concepts and Techniques in Modern Geography 38*, GeoBooks, Norwich.

Taylor, C. (2001) Hierarchies and 'local' markets: the geography of the 'lived' market place in secondary education provision, *Journal of Education Policy* (forthcoming)

Taylor, C., Gorard, S. and Fitz, J. (2000a) A re-examination of segregation indices in terms of compositional invariance, *Social Research Update*, 30.

Taylor, C., Gorard, S. and Fitz, J. (2000b) *Size matters: does school choice lead to 'spirals of decline'? Measuring Markets: the case of the ERA 1988 Working Paper 36*, Cardiff: School of Social Sciences , ISBN 1872330339, 43 pages

Tobler, W.R. (1991) Frame independent spatial analysis. In Goodchild, M.F. and Gopal, S. (eds), *Accuracy of Spatial Databases*, Taylor and Francis, London, pp.115-122.

Wrigley, N. (1995) Revisiting the modifiable areal unit problem and the ecological fallacy. In Cliff, A.D., Gould, P.R., Hoare, A.G. and Thrift, N.J. (eds), *Diffusing Geography: Essays for Peter Haggett*, Blackwell, Oxford, pp.49-71.

Wong, D.W.S. (1997) Spatial dependency of segregation indices, *The Canadian Geographer* 4, 128-136.

Wong, D.W.S. (1999) Exploring the variability of segregation index D with scale and zonal systems: an analysis of thirty US cities, *Environment and Planning A*, 31, 507-522.